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## Statistics for laboratory scientists

### Homework problems for lecture 4

[Source: Freedman, Pisani, Purves (1998) *Statistics*, 3rd ed., Ch 2.]

- (Hypothetical) One of the drugs in the Coronary Drug Project was nicotinic acid. Suppose the results on nicotinic acid were as reported below. Something looks wrong. What and why?

	<u>Nicotinic acid</u>		<u>Placebo</u>	
	<i>Number Deaths</i>		<i>Number Deaths</i>	
Adherers	558	13%	1,813	15%
Non-adherers	487	26%	882	28%
Total group	1,045	19%	2,695	19%

- Some studies find an association between liver cancer and smoking. However, alcohol consumption is a confounding variable. This means--
  - Alcohol causes liver cancer
  - Drinking is associated with smoking, and alcohol causes liver cancer.

Choose one option, and explain briefly.

- Cervical cancer is more common among women who have been exposed to the herpes virus, according to many observational studies. Is it fair to conclude that the virus causes cervical cancer?
- Physical exercise is considered to increase the risk of spontaneous abortion. Furthermore, women who have had a spontaneous abortion are more likely to have another. One observational study finds that women who exercise regularly have fewer spontaneous abortions than other women. Can you explain the findings of this study?
- A hypothetical university has two departments, A and B. There are 2,000 male applicants, of whom half apply to each department. There are 1,100 female applicants: 100 apply to department A and 1,000 to

department B. Department A admits 60% of the men who apply and 60% of the women. Department B admits 30% of the men who apply and 30% of the women. "For each department, the percentage of men admitted equals the percentage of women admitted; this must be so for both departments together." True or false, and explain briefly.

6. The Public Health Service studied the effects of smoking on health, in a large sample of representative households. For men and for women in each age group, those who had never smoked were on average somewhat healthier than the current smokers, but the current smokers were on average much healthier than those who had recently stopped smoking.
  - a. Why did they study men and women and the different age groups separately?
  - b. The lesson seems to be that you shouldn't start smoking, but once you've started, don't stop. Comment briefly.
  
7. According to a study done at Kaiser Permanente in Walnut Creek, California, users of oral contraceptives have a higher rate of cervical cancer than non-users, even after adjusting for age, education, and marital status. Investigators concluded that the pill causes cervical cancer.
  - a. Is this a controlled experiment or an observational study?
  - b. Why did the investigators adjust for age? education? marital status?
  - c. Women using the pill were likely to differ from non-users on another factor which affects the risk of cervical cancer. What factor is that?
  - d. Were the conclusions of the study justified by the data? Answer yes or no, and explain briefly.
  
8. A study of young children found that those with more body fat tended to have more "controlling" mothers; the *San Francisco Chronicle* (Nov 9, 1994) concluded that "Parents of Fat Kids Should Lighten Up."
  - a. Was this an observational study or a randomized controlled

experiment?

- b. Did the study find an association between mother's behavior and her child's level of body fat?
- c. If controlling behavior by the mother causes children to eat more, would that explain an association between controlling behavior by the mother and her child's level of body fat?
- d. Suppose there is a gene which causes obesity. Would that explain the association?
- e. Can you think of another way to explain the association?
- f. Do the data support the *Chronicle's* advice on child-rearing?

Discuss briefly.

9. California is evaluating a new program to rehabilitate prisoners before their release; the object is to reduce the recidivism rate---the percentage who will be back in prison within two years of release. The program involves several months of "boot camp"---military-style basic training with very strict discipline. Admission to the program is voluntary. According to a prison spokesman, "Those who complete boot camp are less likely to return to prison than other inmates."
  - a. What is the treatment group in the prison spokesman's comparison? the control group?
  - b. Is the prison spokesman's comparison based on an observational study or a randomized controlled experiment?
  - c. True or false: the data show that boot camp worked.

Explain your answers.

10. (Hypothetical.) A study is carried out to determine the effect of party affiliation on voting behavior in a certain city. The city is divided up into wards. In each ward, the percentage of registered Democrats who vote is higher than the percentage of registered Republicans who vote. True or false: for the city as a whole, the percentage of registered Democrats who vote must be higher than the percentage of registered Republicans who vote. If true, why? If false, give an

example.

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